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| Frequency band (lower limit exclusive, upper limit inclusive), and categories of stations | Tolerance ¹ | Tolerance ² |
|---|--------------------------------|--------------------------------|
| Survival craft stations on 121.5 MHz. | 50 | 50 |
| Emergency locator stations | 50 | 50 |
| Aircraft and other mobile stations in the Aviation Services. | ⁵ 50 | ¹³ 30 |
| Radionavigation stations | 20 | 20 |
| Differential GPS | | 2 |
| (6) Band-137 to 470 MHz: | | |
| Aeronautical stations | 50 | 20 |
| Survival craft stations on 243 MHz. | 50 | 50 |
| Aircraft stations | ⁵ 50 | ³⁰ ¹⁰ |
| Radionavigation stations | 50 | 50 |
| Emergency locator transmitters on 406 MHz. | N/A | 5 |
| (7) Band-470 to 2450 MHz: | | |
| Aeronautical stations | 100 | 20 |
| Aircraft stations | 100 | 20 |
| Aircraft earth station | | 320 Hz ¹¹ |
| Aeronautical utility mobile stations on 1090 MHz. | 1000 | 1000 |
| Radionavigation stations: | | |
| 470–960 MHz | 500 | 500 |
| 960–1215 MHz | 20 | 20 |
| 1215–2450 MHz | 500 | 500 |
| (8) Band-2450 to 10500 MHz: | | |
| Radionavigation stations | ⁶ ⁹ 1250 | 1250 ⁶ ⁹ |
| (9) Band-10.5 GHz to 40 GHz: | | |
| Radionavigation stations | 5000 | 5000 |

¹ This tolerance is the maximum permitted until January 1, 1990, for transmitters installed before January 2, 1985, and used at the same installation. Tolerance is indicated in parts in 10⁶ unless shown as Hertz (Hz).

² This tolerance is the maximum permitted after January 1, 1985 for new and replacement transmitters and to all transmitters after January 1, 1990. Tolerance is indicated in parts in 10⁶ unless shown as Hertz (Hz).

³ For transmitters first approved after November 30, 1977.

⁴ The tolerance for transmitters approved between January 1, 1966, and January 1, 1974, is 30 parts in 10⁶. The tolerance for transmitters approved after January 1, 1974, and stations using offset carrier techniques is 20 parts in 10⁶.

⁵ The tolerance for transmitters approved after January 1, 1974, is 30 parts in 10⁶.

⁶ In the 5000 to 5250 MHz band, the FAA requires a tolerance of ±10 kHz for Microwave Landing System stations which are to be a part of the National Airspace System (FAR 171).

⁷ For single-sideband transmitters operating in the frequency bands 1605–4000 kHz and 4–29.7 MHz which are allocated exclusively to the Aeronautical Mobile (R) Service, the tolerance is: Aeronautical stations, 10 Hz; aircraft stations, 20 Hz.

⁸ For single-sideband radiotelephone transmitters the tolerance is: In the bands 1605–4000 kHz and 4–29.7 MHz for peak envelope powers of 200 W or less and 500 W or less, respectively, 50 Hz; in the bands 1605–4000 kHz and 4–29.7 MHz for peak envelope powers above 200 W and 500 W, respectively, 20 Hz.

⁹ Where specific frequencies are not assigned to radar stations, the bandwidth occupied by the emissions of such stations must be maintained within the band allocated to the service and the indicated tolerance does not apply.

¹⁰ Until January 1, 1997, the maximum frequency tolerance for transmitters with 50 kHz channel spacing installed before January 2, 1985, is 50 parts in 10⁶.

¹¹ For purposes of certification, a tolerance of 160 Hz applies to the reference oscillator of the AES transmitter. This is a bench test.

¹² For emissions G1D and G7D, the tolerance is 2 parts per 10⁶.

¹³ For emissions G1D and G7D, the tolerance is 5 parts per 10⁶.

(b) The power shown in paragraph (a) of this section is the peak envelope power for single-sideband transmitters

and the mean power for all other transmitters.

(c) For single-sideband transmitters, the tolerance is:

(1) All aeronautical stations on land—10 Hz.

(2) All aircraft stations—20 Hz.

(d) For radar transmitters, except non-pulse signal radio altimeters, the frequency at which maximum emission occurs must be within the authorized frequency band and must not be closer than 1.5/T MHz to the upper and lower limits of the authorized bandwidth, where T is the pulse duration in microseconds.

(e) The Commission may authorize tolerances other than those specified in this section upon a satisfactory showing of need.

(f) The carrier frequency tolerance of transmitters operating in the 1435–1535 MHz and 2310–2390 MHz bands manufactured before January 2, 1985, is 0.003 percent. The carrier frequency tolerance of transmitters operating in the 1435–1535 MHz and 2310–2390 MHz bands manufactured after January 1, 1985, is 0.002 percent. After January 1, 1990, the carrier frequency tolerance of all transmitters operating in the 1435–1535 MHz and 2310–2390 MHz bands is 0.002 percent.

(g) Any aeronautical enroute service transmitter operating in U.S. controlled airspace with 8.33 kHz channel spacing (except equipment being tested by avionics equipment manufacturers and flight test stations prior to delivery to their customers for use outside U.S. controlled airspace) must achieve 0.0005% frequency stability when operating in that mode.

[53 FR 28940, Aug. 1, 1988, as amended at 56 FR 38084, Aug. 12, 1991; 57 FR 45749, Oct. 5, 1992; 58 FR 31027, May 26, 1993; 63 FR 36607, July 7, 1998; 64 FR 27474, May 20, 1999; 66 FR 26799, May 15, 2001; 69 FR 32880, June 14, 2004; 76 FR 17350, Mar. 29, 2011; 78 FR 61205, Oct. 3, 2013]

§ 87.135 Bandwidth of emission.

(a) Occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 percent of the total mean power of a given emission.

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(b) The authorized bandwidth is the maximum occupied bandwidth authorized to be used by a station.

(c) The necessary bandwidth for a given class of emission is the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

§ 87.137 Types of emission.

(a) The assignable emissions, corresponding emission designators and authorized bandwidths are as follows:

| Class of emission | Emission designator | Authorized bandwidth (kilohertz) | | Frequency deviation |
|----------------------------|---------------------|----------------------------------|--------------------|---------------------|
| | | Below 50 MHz | Above 50 MHz | |
| A1A ¹ | 100HA1A | 0.25 | | |
| A1N | 300HA1N | | 0.75 | |
| A2A | 2K04A2A | 2.74 | 50 | |
| A2D | 6K0A2D | | 50 | |
| A2D ⁵ | 13K0A2D | | 50 | |
| A3E ² | 6K00A3E | | 50 ³ | |
| A3E | 5K6A3E | | 8.33 | |
| kHz ¹⁷ | | | | |
| A3X ⁴ | 3K20A3X | | 25 | |
| A9W ⁵ | 13K0A9W | | 25 | |
| F1B ¹ | 1K70F1B | 1.7 | | |
| F1B ¹ | 2K40F1B | 2.5 | | |
| F1D ¹⁸ | 1M30F1D | | 1300 kHz | 312.5 kHz |
| F2D | 5M0F2D | | (⁹) | |
| F3E ⁶ | 16K0F3E | | 20 | 5 |
| F3E ⁷ | 36K0F3E | | 40 | 15 |
| F7D ⁸ | 5M0F7D | | 9 | |
| F9D | 5M0F9D | | 9 | |
| G1D | 16K0G1D | | 20 kHz | |
| G1D ¹⁶ | 21K0G1D | | 25 | |
| G1D | 14K0G1D | | 25 | |
| F9D | 5M0F9D | | 9 | |
| G1D | 16K0G1D | | 20 kHz | |
| G3E ⁶ | 16K0G3E | | 20 | 5 |
| G7D | 14K0G7D | | 25 | |
| H2B ^{10 11} | 2K80H2B | 3.0 | | |
| H3E ^{11 12} | 2K80H3E | 3.0 | | |
| J2A ¹ | 100HJ2A | 0.25 | | |
| J2B ¹ | 1K70J2B | 1.7 | | |
| | 2K40J2B | 2.5 | | |
| J3E ^{11 12} | 2K80J3E | 3.0 | | |
| J7B ¹¹ | 2K80J7B | 3.0 | | |
| J7D | 5M0J7D | | 9 | |
| J9W ¹¹ | 2K80J9W | 3.0 | | |
| M1A | 620HM1A | | | |
| M1D | 14M0M1D | 14.0 | | |
| NON | NON | | None ¹⁵ | |
| PON ¹³ | | | 9 | |
| R3E ^{11 12} | 2K80R3E | 3.0 | | |
| XXA ¹⁴ | 1K12XXA | 2.74 | | |

NOTES:

¹ A1A, F1B, J2A and J2B are permitted provided they do not cause harmful interference to H2B, J3E, J7B and J9W.

² For use with an authorized bandwidth of 8.0 kilohertz at radiobeacon stations. A3E will not be authorized:

(i) At existing radiobeacon stations that are not authorized to use A3 and at new radiobeacon stations unless specifically recommended by the FAA for safety purposes.

(ii) At existing radiobeacon stations currently authorized to use A3, subsequent to January 1, 1990, unless specifically recommended by the FAA for safety purposes.

³ In the band 117.975–136 MHz, the authorized bandwidth is 25 kHz for transmitters approved after January 1, 1974.

⁴ Applicable only to Survival Craft Stations and to the emergency locator transmitters and emergency locator transmitter test stations employing modulation in accordance with that specified in § 87.141 of the Rules. The specified bandwidth and modulation requirements shall apply to emergency locator transmitters for which approval is granted after October 21, 1973.

⁵ This emission may be authorized for audio frequency shift keying and phase shift keying for digital data links on any frequency listed in § 87.263(a)(1), § 87.263(a)(3) or § 87.263(a)(5). 13K0A2D emission may be authorized on frequencies not used for voice communications. If the channel is used for voice communications, 13K0A9W emission may be authorized, provided the data is multiplexed on the voice carrier without derogating voice communications.

⁶ Applicable to operational fixed stations in the bands 72.0–73.0 MHz and 75.4–76.0 MHz and to CAP stations using F3 on 143.900 MHz and 148.150 MHz.

⁷ Applicable to operational fixed stations presently authorized in the band 73.0–74.6 MHz.

⁸ The authorized bandwidth is equal to the necessary bandwidth for frequency or digitally modulated transmitters used in aeronautical telemetry and associated aeronautical telemetry or telecommand stations operating in the 1435–1535 MHz and 2310–2390 MHz bands. The necessary bandwidth must be computed in accordance with part 2 of this chapter.

⁹ To be specified on license.

¹⁰ H2B must be used by stations employing digital selective calling.

¹¹ For A1A, F1B and single sideband emissions, except H2B, the assigned frequency must be 1400 Hz above the carrier frequency.

¹² R3E, H3E, and J3E will be authorized only below 25000 kHz. Only H2B, J3E, J7B, and J9W are authorized, except that A3E and H3E may be used only on 3023 kHz and 5680 kHz for search and rescue operations.

¹³ The letters "K, L, M, Q, V, W, and X" may also be used in place of the letter "P" for pulsed radars.

¹⁴ Authorized for use at radiobeacon stations.

¹⁵ Applicable only to transmitters of survival craft stations, emergency locator transmitter stations and emergency locator transmitter test stations approved after October 21, 1973.

¹⁶ Authorized for use by aircraft earth stations. Lower values of necessary and authorized bandwidth are permitted.

¹⁷ In the band 117.975–137 MHz, the Commission will not authorize any 8.33 kHz channel spaced transmissions or the use of their associated emission designator within the U.S. National Airspace System, except, on an optional basis, by Aeronautical Enroute Stations and Flight Test Stations, or by avionics equipment manufacturers which are required to perform installation and checkout of such radio systems prior to delivery to their customers. For transmitters certificated to tune to 8.33 kHz channel spacing as well as 25 kHz channel spacing, the authorized bandwidth is 8.33 kHz when tuned to an 8.33 kHz channel.

¹⁸ Authorized only for Universal Access Transceiver use at 978 MHz.

(b) For other emissions, an applicant must determine the emission designator by using part 2 of this chapter.

(c) A license to use radiotelephony includes the use of tone signals or signaling devices whose sole function is to establish or maintain voice communications.

[53 FR 28940, Aug. 1, 1988, as amended at 55 FR 7333, Mar. 1, 1990; 55 FR 13535, Apr. 11, 1990; 55 FR 28627, July 12, 1990; 56 FR 11518, Mar. 19, 1991; 57 FR 45749, Oct. 5, 1992; 58 FR 30127, May 26, 1993; 63 FR 36607, July 7, 1998; 63 FR 68957, Dec. 14, 1998; 64 FR 27475, May 20, 1999; 66 FR 26799, May 15, 2001; 69 FR 32881, June 14, 2004; 71 FR 70676, Dec. 6, 2006; 76 FR 17351, Mar. 29, 2011; 78 FR 61205, Oct. 3, 2013]